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TITLE

MOORING SYSTEM FOR FLUID CARGO TANKERS

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MOORING SYSTEM FOR FLUID CARGO TANKERS

BACKGROUND OF THE INVENTION

REFERENCE TO RELATED APPLICATION

[0001] This application claims priority from U.S. Provisional Patent Application
5 Serial Number 60/441,069 filed January 17, 2003.

FIELD

[0002] The present invention pertains to the transportation of fluid cargo; more particularly, the present invention pertains to a mooring and fluid transfer system to be used with ocean-going liquid cargo transport vessels.

10 **BACKGROUND**

[0003] Many fluid cargo tankers, particularly those carrying a volatile cargo of liquids, gases, or a combination thereof, are offloaded in protected locations. Accordingly, LNG tankers are typically moored alongside a special quay. This special quay is located in a protected location where damage, in the event of an explosion, would be minimized.

15 [0004] From both an efficiency and safety standpoint, it would be desirable to offload fluid cargo tankers, particularly LNG tankers, offshore. However, the key disadvantage to offshore offloading is the fact that weather and wave conditions cause the LNG tanker vessels to be in a continuous state of motion. Hence, it is difficult for loading arms, even articulated loading arms, to cope with the continuous motion of a tanker moored
20 offshore. Accordingly, a need remains in the art for a mooring and transfer system that can be used with fluid cargo tankers at an offshore location.

SUMMARY

[0005] One object of the present invention is to provide a mooring system for fluid cargo tankers which acts as an “offshore quay,” about which a fluid cargo tanker can moor in such a fashion that single point mooring technology, such as described in US Patent No. 5,584,607, to the same assignee, can be applied. The disclosed mooring system can be fitted with the same type of conventional steel loading arms and flexible hose connections used at onshore facilities.

[0006] The mooring and transfer system of the present invention for use with oceangoing fluid cargo vessels includes an extended length space frame. The extended length space frame is supported by a first column secured to the ocean floor on one end and a second buoyant column located on the opposite end of the extended length space frame. The second buoyant column is supported by a substantially flat buoyant tank. A system for mooring the vessel is located at the end of the rigid space frame supported by the first column. A system for changing the direction and/or orientation of the rigid length space frame is located near the second buoyant column. The transfer of liquid cargo from the vessel is accomplished at the end of the space frame near the second buoyant column.

BRIEF DESCRIPTION OF THE DRAWING FIGURES

[0007] A still better understanding of the mooring and transfer system for use with liquid cargo vessels may be had by reference to the drawing figures, wherein:

Figure 1 is a left front perspective view of the system of the present invention;

Figure 2 is a left rear perspective view;

Figure 3A is a top plan view of the system shown in Figure 1;

Figure 3B is a side elevational view; and

Figure 3C is a left side elevational view.

DESCRIPTION OF THE EMBODIMENTS

5 [0008] In its preferred embodiment, the mooring and fluid transfer system **10** of the present invention is configured as shown in the drawing figures:

 [0009] A rigid space frame **20** is supported on its first end **22** in a shallow depth body of water **100**, generally less than 30 metres deep, by a first seabed supported column **30** and on its second end **24** by a buoyancy system **40**. As shown in Figure 3C, the first column **30**
10 includes a generally large diameter steel base plate **32**. The steel base plate **32** is secured to the seabed by a plurality of piles **34**.

 [0010] The first column **30** is fitted with a rotating collar **36**. The rotating collar **36** is pivotally attached to the rigid space frame **20** by a hinge arrangement **38**. The operating axis of the hinge arrangement **38** is located transverse to the longitudinal direction of the
15 rigid space frame **20**.

 [0011] The buoyancy system **40**, located on the opposite end of the rigid space frame **20** from the first column **30**, is configured as a relatively “flat” tank **60** in the preferred embodiment, such that a large area is exposed to wave action. The flat shape of the tank **60** gives it the appearance of a “plate” running parallel to the seabed.

[0012] The volume and buoyancy of the tank 60 provides support for approximately half the weight rigid space frame 20, together with all of the fluid transfer and orientation equipment to be placed thereon. A column 62 rises substantially vertically from the tank 60 through the water surface. Column 62 is also buoyant.

5 [0013] The combination of the flat horizontal tank 60 and the buoyant column 62, which has a small waterline area, is that under the action of wind and waves, the resulting vertical motion of the rigid space frame 20, at its free end, is very small. This small vertical motion of the rigid space frame 20 is due to a low restoring stiffness provided by the small waterline area of the column 62 and a large entrapped mass provided by the flat horizontal
10 tank 60.

[0014] The equipment 70 used to offload liquid cargo from a vessel 150 is placed on top of the column 62.

[0015] The rigid space frame 20 may also be fitted with thrusters 80 at its free end. The thrusters 80 enable the entire assembly to orient itself directionally about column 30.
15 Those of ordinary skill in the art will understand that the space frame assembly 20 will align itself with the waves, current and wind such that a vessel transporting liquid cargo, wishing to moor alongside the space frame 20, can do so against the prevailing environment and still be fully stable and steerable.

[0016] To facilitate the use of a single point mooring system 120, rather than tying
20 up using multiple mooring lines, a mooring pole 90 may be introduced. This mooring pole 90 is fitted in a semi-rigid manner to the rigid space frame 20, preferably at a location just

forward of the column 30 and extending laterally from the rigid space frame 20 over half the width of the vessel. The mooring pole 90 is attached 92 in a rotatable manner to the rigid space frame 20 and extends the width of the space frame 20 to engage a stopper 96 which prevents the mooring pole 90 from moving under loads exerted by the vessel 150. If the vessel 150 were to ride up and overshoot its position along the rigid space frame 20, the mooring pole 90 is able to rotate forward around connection 92 and hence no obstacle or hazard would be presented to the vessel 150.

[0017] Generally used, the disclosed system includes the following method steps:

- The extended length space frame 20 is positioned along a preferred azimuth with respect to column by means of its thrusters 80.
- The vessel 150 moors to the mooring pole 90 by a single hawser 120.
- The thrusters 80 are activated as needed to maintain a preset determined separation distance between the side of the vessel 150 and the space frame 20. Alternatively, the thrusters 80 may cause the space frame 20 to exert a very slight push against the side of the vessel 150.
- The fluid transfer connection between the loading equipment 70 on the top of the column 62 and the vessel 150 is made up.
- The liquid cargo is then pumped from the vessel 150 through flowlines 140 incorporated in the space frame 20 through a swivel assembly 72 on top of the

column 62, and then through flowlines connected to pipelines resting on the seabed which lead to an onshore location.

[0018] This disclosed system and method is particularly suited to the conveyance of cryogenic fluids such as LNG.

5 [0019] In offshore areas characterized by large waves and where the water is very shallow, less than 20 metres, the buoyancy system 40 may be flooded so that the weight of the free end of the space frame 20 may be supported by the seabed.

[0020] In certain locations it may be an advantage to fit the above described system with a vaporiser system for LNG, such that voids may be replaced by vaporised LNG, doing
10 away with the need to import such vapours from an outlying source through submarine pipelines.

[0021] While the present system and method has been disclosed according to the preferred embodiment of the invention, those of ordinary skill in the art will understand that other embodiments have also been enabled. Such other embodiments shall fall within the
15 scope and meaning of the appended claims.